LETTERS TO THE EDITOR.

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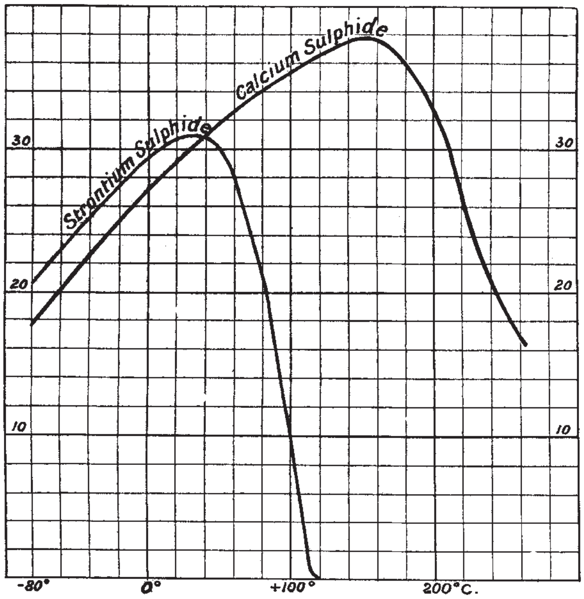
Effect of Change in Temperature on Phosphorescent Substances.

WHEN a substance that possesses phosphorescent properties is exposed to suitable light vibrations, it is found to glow with a certain brightness when the light is shut off.

When such substances are exposed under *similar conditions* for a sufficient length of time the intensity of the phosphorescent light emitted reaches a maximum, which maximum is constant for each substance.

If now the temperature of the substance under observation be altered, the other conditions remaining the same, it is found that the maximum intensity of the light emitted varies with the temperature, and that the maximum for any temperature is constant for that temperature.

The light to which the substances under observation were exposed was that from a spark discharge of a Leyden jar coupled up with the terminals of an induction coil. The instant the spark is stopped, the intensity of the light emitted by the substance is estimated by a photometer devised for the purpose. The principle of the photometer consists in diminishing light that shines through an aperture of given area, by interposing thin sheets of oil paper. A slip of glass is also interposed, of the same colour as the light emitted by the phosphorescent substance. As yet this photometer has only been used to compare the maximum intensity of the light emitted from the same substance at different temperatures. Now let us suppose, for example, that with a specimen of calcium sulphide at −40° C. ten papers had to be interposed before the light emitted from the sulphide and that from the photometer were of equal intensity; while at 96° C. only seven papers had to be interposed. By taking the reciprocal of the antilog of 10 and the reciprocal of the antilog of 7, we have a rough measure of the relative intensity of the light emitted at −40° and +96° respectively. The antilogs were plotted to scale, and from the curves thus obtained, the accompanying reciprocal curves, showing how the light emitted varies with the temperature, were plotted.



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Sinistral Screws.

IF mechanical screws "bear" upon natural spirals, as of the *Gasteropoda* (NATURE, May 27, p. 79), it may be worth while to observe that sinistral forms survive in art, as in nature.

The silversmiths of Western India still commonly use a sinistral screw of very primitive form, a pin with a wire twisted round it, especially in the buckles of silver belts; things of very common wear. Europeans, coming into possession of such jewellery, are often sorely puzzled how to open and shut it. Yet these people are as right-handed as we; and write, as we do, "*with* the sun." W. F. SINCLAIR.

102 Cheyne Walk, Chelsea, S.W., May 28.

Luminous Phenomena observed on Mountains.

THE following account of an occurrence somewhat similar to those recently recorded in NATURE may be of interest. I will give it in the observer's (Rev. W. E. Postlethwaite) own words.

"On March 5, at 9 p.m., I was crossing the Towans, wind north-west; a slight shower came on, which lasted about ten minutes. During that time my hat-brim, ferrule of walking-stick, finger-tips, and the edges of a book I was carrying were phosphorescent, the same colour, and in some places as bright, as the light emitted by a glow-worm. The light was the brightest on the windward side."

The "Towans" referred to in the foregoing account are near Helston, Cornwall, on the sea coast, with an altitude ranging from sea-level to 174 feet above, and with a general downward inclination towards the north-west.

Trewirgie, Redruth, May 29. ARTHUR P. JENKIN.

The Designation of Wave-Clouds.

IN a general article on the "Photographic Observation of Clouds," published in NATURE of February 4 (vol. lv. p. 332), you call attention to the wave-clouds, the origin of which was first explained by Helmholtz, and remark that the name of "Wogen wolken" has been suggested as their designation. May I call your attention to a paper I read before the Linnean Society of New South Wales on August 29, 1894, in which the name *undulus* is suggested for the ripple- or wave-clouds. The name has the advantage of falling easily into line with Howard's nomenclature. And some name is necessary, for out of combinations of the elementary forms *stratus*, *cumulus*, *cirrus*, and *undulus* can be derived most of the diversified and ever-changing cloud-groups, which never cease to delight and astonish the eye and mind of man. A. H. S. LUCAS.

Newington College, Sydney, April 16.

THE BAKERIAN LECTURE.—ON THE MECHANICAL EQUIVALENT OF HEAT.[1]

THE purpose of this research differs essentially from that of any previous research on the mechanical equivalent of heat. In order to diminish the loss of heat by radiation, as well as to obtain the equivalent for water in the neighbourhood of ordinary temperatures, the ranges of temperature over which the previous dynamical measurements have been made are greatly less than the standard interval between the physically fixed points of temperature to which all thermal measures are referred, and so have of necessity involved the use of scales, the intervals of which depend on the constancy of the relative expansions of such substances as glass, mercury, and air. On the other hand, in this research the object has been to determine the mechanical equivalent of the total heat necessary to raise the temperature of water over the standard interval of temperature, and thus to obtain directly the equivalent of the mean specific heat between the freezing and boiling points.

This undertaking is the result of the occurrence of circumstances which afforded an opportunity such as might not again occur. This consisted in the facilities offered by the appliances which formed the original equipment of the Whitworth Engineering Laboratory, in 1888, the more essential of these being an engine of 100 H.P., working one of Prof. Reynolds' hydraulic brakes. This brake maintains any constant moment of resistance on the engine shaft, independent of the speed, all the work done being converted into heat, which appears in the rise of temperature of a steady stream of water flowing through the brake, the magnitude of which stream is independent of the load on the brake or the speed of the engine, and is under independent control.

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[1] By Prof. Osborne Reynolds, F.R.S., and W. H. Moorby. Read before the Royal Society, May 20. [Abstract.]

The existence of the Manchester town's water, of a purity expressed by 3 grains of salts to the gallon, conveniently distributed in the laboratory, as well as auxiliary power, both steam and water.

Although unconsciously, the research was really commenced in 1890, when, without any intention of making a determination of the heat equivalent of the work done on the brake, but solely for the purpose of verifying the mechanical balance of the brake, provision for thermal measurements was added, and a system of trial instituted, in which the object sought was only that of obtaining consistent results over definite portions of the scales of uncorrected thermometers, eliminating the errors resulting from radiation by taking the differences of two trials. In these trials the temperature ranged from 40° to 50° F., and their development was continued over two years. Then it occurred to Prof. Reynolds that by the same method the great facility which this brake was then seen to afford would be available for the independent determination of the mechanical equivalent, if it could be arranged that water should enter the brake at the temperature of melting ice, and leave it at that of water boiling under the standard pressure. Since then all that would be required of the thermometers would be the identification of these temperatures, and with a range of 180° the error in scale over one or two degrees would be comparatively of small importance. At first the difficulties seemed formidable; but on trying by gradually diminishing the supply of water to the brake when it was absorbing 60 H.P., and finding that it ran steadily under control of its automatic gear till the temperature was within three or four degrees of boiling, he further considered the matter, and during the next two years convinced himself of the practicability of the necessary additional appliances by preliminary designs. These consisted of:—

(1) An artificial atmosphere or means of maintaining a steady air pressure of 4/3 atmosphere in the air passages of the brake.

(2) A circulating pump and water cooler, by which the entering water, some 30 lbs. a minute, could be forced through the cooler into the brake at a temperature of 32°, having been cooled by ice from the temperature of the town's main.

(3) A condenser by which the water leaving the brake at 212° might be cooled down to atmospheric temperature before being discharged into the atmosphere and weighed.

(4) Such alteration in the manner of supporting the brake on the shaft as would prevent excess of leakage from the bushes in consequence of the greater pressure of air in the brake, since not only would the leaks be increased, but when the rise of temperature was increased to 180° the quantity for any power would be diminished to one-sixth of that for a rise of 30°, so that any leakage would become six times the relative importance.

(5) Some means by which assurance of the elimination of the radiation and conduction could be obtained, as with a temperature of 140° F. above the laboratory these would probably amount to 2 or 3 per cent. of the total heat.

(6) Scales for greater facility and accuracy in weighing the water with a switch actuated by the counter.

(7) A pressure gauge or barometer by which the standard for the boiling-points might be readily determined at 3° or 4° F. above and below the boiling-point, so as to admit of ready and frequent correction of the thermometers used for identifying the temperature of the effluent water.

(8) Some means of determining the terminal differences of temperature and quantities of water in the brake, which would be relatively six times as large as with 30° rise.

These preliminary designs apparently demonstrated the practicability of the appliances, and also the possibility of their inclusion in the already much occupied space adjacent to the brake. But there remained still much to be done in the way of experimental investigation in order to obtain the data for proportioning the appliances.

In July 1894, Mr. Moorby having undertaken to devote himself to the research, the experiments necessary for the appliances were at once commenced, and these, together with the construction of the appliances and then standardising, and preliminary experiments while this was in progress, occupied till February 1896, when Mr. Moorby commenced the main experiments, which were continued into July 1896.

In these experiments the time of running was 62 minutes; the speed 300 revolutions a minute, on the speed gauges. Observations of speeds, of the temperature of the inflowing and effluent water, and of the temperature of the air were made every two minutes. Observations of the slope of the temperature of the shaft were made every eight minutes.

The temperature of the inflowing water varied from 32·5° to 34°, and that of the effluent from 210° to 214° F. The effluent water was cooled to 8·5° before entering the tank on the scales, in which it was weighed, weighings being taken before and after each trial.

The temperature of the metal surface of the brake being sensibly the same as that of the effluent water (212°), and by taking the difference in the work absorbed in two trials and the differences in the heats developed the errors of radiation and balance in the brake were approximately eliminated, and in order to complete the elimination the coefficient of radiation was approximately determined, so that a correction might be applied for any residual differences of temperature as observed, and in the same way with the slope of temperatures. Further assurance was also obtained by making some trials with the brake naked and others with it covered, so as to reduce the loss of heat to one-fifth; and, in the same way, with every circumstance which could effect the result trials, means were taken to vary the circumstances in different series of trials, so as to obtain an estimate of the limits of error. All the appliances were most carefully standardised; and taking all the limits of error into account the limit of the sum was less than 0·0003.

In all fifty-two trials were included in the final result. Of these—

25 with loads on the brake of 1200 ft.-lbs. at 70 H.P.
21 ,, ,, 600 ,, 35 ,,
6 ,, ,, 400 ,, 23 ,,

From these, twenty-five separate determinations were made of the equivalent, subject to certain general corrections given below, which gave a mean value 777·91, and from this none of the separate determinations differed by as much as 0·2 per cent., which arranged in eight groups, according to the circumstances under which they were made, the greatest divergence from the mean was 0·05 per cent.

It was found impracticable to eliminate entirely from each determination the losses of heat due to radiation, conduction, leakage of water, &c., and so it was found advisable to determine what these losses were. This information was given by the trials themselves, and the necessary corrections were applied to each separate determination. As illustrating the extent to which the method adopted did eliminate these errors, it is interesting to remark that on the mean value of the equivalent determined, without taking these errors into account, the error was only 0·0192 per cent.

Certain final corrections, which had the same values for all trials, were made to the mean value of J, already given. These were introduced on the following various counts:—

I. Length of the brake lever (0·00042).
II. Salts dissolved in Manchester water (0·00003).
III. Air dissolved in water used in the trials (– 0·00021).
IV. Reduction of weighings to vacuo (– 0·00120).
V. Varying specific heat of water (– 0·00006).
VI. Pressure on thermometer bulbs (– 0·00037).
VII. Work done against gravity (0·00007).
VIII. Engagement of counter (0·00001).

Their total effect was to introduce a correction factor of (1 – 0·00125).

The mean corrected value of the specific heat of water between freezing and boiling points, as measured in mechanical units at Manchester, is found to be 776·94.

THE INTERNATIONAL GEOLOGICAL CONGRESS IN RUSSIA.

THE International Geological Congress may be said to come of age this year, for it was founded at Philadelphia in 1876, at a meeting held under the presidency of the veteran James Hall. The first organised session was held at Paris in 1878, and since then meetings have taken place at Bologna, Berlin, London, Washington, and Zürich. The seventh session is to be held at St. Petersburg, with Prof A. Karpinsky as President.

The ordinary meetings of the Congress will be held in the rooms of the Imperial Academy of Sciences at St. Petersburg. There will be a preliminary assembly of the members on August 28, the formal opening will take place on the following day, and the meeting will terminate on September 4. According to the Russian Calendar these dates will be twelve days earlier, namelv. August 16, 17, and 23.

The meetings will extend over eight hours. From 9 till 10 a.m. the Committees of the Congress will deliberate; from 10 till 2 p.m. there will be discussions on questions proposed in the programme of the Organising Committee. One hour is then set aside for visits to museums and to the exhibition of maps, sections, books, specimens and instruments—possibly some members may then take the opportunity of obtaining lunch. From 3 to 5 o'clock papers of a general character will be read, and these will be so arranged that only one branch of geological science will be discussed each day.

The Organising Committee will reopen the subject of the unification of geological nomenclature. The larger divisions of the earth's history must be based on general palæontological characters, and in defining the several systems attention will be specially given to the study of pelagic life and the evidences of organic evolution. In order that a system be well established it must be capable of subdivision into stages characterised by well-marked pelagic faunas, and these should have a European or equivalent value. It is recognised that sub-stages have only a regional value, while minor divisions have but a local character, and with these the Congress does not deal. The divisions, in short, which the assembly will be called upon to discuss are those of geological time, based on the occurrence of successive groups and zones of fossils; the purely stratigraphical divisions are essentially regional or local, and they may reasonably be left for each country to fix according to its own necessities; for they are all important in the interpretation of the structure of a district, in determining its economic resources, and in explaining the origin of its scenery. On the other hand, when we seek to trace out the history of the great changes which the earth at large has undergone, the more comprehensive life-divisions are all important; and these only can be universally applied, and, we hope, universally adopted. It is true that life-divisions are no more to be rigidly defined than are stratigraphical divisions in the rocks, but fossils are the only guides for correlating the formations in countries far apart. There should be no serious disagreement among geologists, at any rate, with regard to the principles of correlation; and there is no reason why, after full and friendly discussion, a particular nomenclature should not be generally accepted. It need not interfere with our local divisions, any more than great chronological terms, if applied to human history in general, would interfere with our own time-divisions marked by the reigns of successive monarchs.

The Organising Committee will also deal with the subject of petrographic nomenclature, in the hope of reducing the number of terms now used, and of preventing unnecessary names being introduced. In petrology, as in palæontology, one is nowadays in constant need of a dictionary or glossary, or table of synonyms, to understand the various names of rocks or rock-structures and fossils.

The scheme for Excursions in connection with the Congress is an elaborate one. There will be excursions both before and after the ordinary meeting, and those who have time and money will have grand opportunities of visiting many parts of the Russian empire in Europe.

Prior to the Congress there will be three excursions; namely, to the Ural regions, to Esthonia, and to Finland. The Ural excursion is timed to take place between July 28 and August 27. There will be a general gathering of the party at Moscow on July 29, and those who join are advised to take thick boots, warm clothing, and waterproof cloaks, for there will be rough walking as well as long journeys in open carriages and on horseback. Messrs. Nikitin, Tschernyschew, Arzruni, Karpinsky, and Stuckenberg will act as leaders. The party will take train to Riazan, and thence journeying to Syzran, on the Volga, they will cross Jurassic, Cretaceous, and Tertiary strata. Thence from Samara to Oufa, Permian and Triassic rocks will be traversed, while onwards to the Ural mountains the party will pass over Carboniferous, Devonian, and Siluro-Cambrian strata, which present evidences of considerable metamorphism, and which, together with various schists, are penetrated by numerous eruptive rocks. The region is famed for its metalliferous deposits, and various mines in rocks bearing gold, copper, and manganese will be visited, as also will be the Imperial stone-cutting works at Ekatherinebourg. The return journey will be made by Perm, Kazan, and Nijni-Novgorod.

The excursion into Esthonia (August 13 to 27) under the direction of M. Schmidt, will be by rail to Reval on the Gulf of Finland, and then a visit will be paid to the Isle of Dago, when attention will be given to the fossiliferous Upper and Lower Silurian rocks.

The excursion to Finland will be made under the guidance of M. W. Ramsáy. The members will assemble at Helsingfors on August 21, and return to St. Petersburg on August 28. Tammerfors and Lavia will be reached, and attention will be directed to the glacial phenomena and the various crystalline rocks.

After the meeting of the Congress is over, the principal excursion will be to the Caucasus, leaving St. Petersburg on September 5, and arriving at Moscow on the following day. The excursion party will then be divided into three sections, A, B, and C. Section A will be conducted by Messrs. Nikitin, Gourow, Tschernyschew, Loutougin, Rouguéwitsch, and Konchin. Leaving Moscow, and travelling by Podolsk, the route will be over Jurassic, Carboniferous and Devonian rocks, and on to the Cretaceous strata of Koursk and Kharkow. Thence the